

AMENDMENTS TO THE CLAIMS

Please amend the present application as follows:

Claims

1. (Currently amended) A light-emitting device, comprising:
a semiconductor light-emitting die; and
a gradient index (GRIN) element having a cylindrical refractive index profile in which the refractive index varies radially and is substantially constant axially, the GRIN element comprising a first end surface opposite a second end surface and further comprising a cylindrical body having a first diameter, the cylindrical body characterized by a length-to-pitch ratio, the GRIN element arranged with the first end surface adjacent the light light-emitting die to receive light therefrom and emitting the light from the second end surface in a radiation pattern dependent on the length-to-pitch ratio;
a header comprising a cavity extending thereinto, the cavity having a second diameter slightly smaller than the first diameter, the light-emitting die mounted in the cavity defined by the header; and
a push fit hermetic seal defined by an assembly comprising the GRIN element engaged in the cavity.
2. (Original) The light-emitting device of claim 1, in which:
the length-to-pitch ratio is equal to one fourth; and
the GRIN element emits the light in a collimated beam.
3. (Withdrawn) The light-emitting device of claim 1, in which:
the length-to-pitch ratio is less than one fourth; and
the GRIN element emits the light in a diverging beam.
4. (Withdrawn) The light-emitting device of claim 1, in which:
the length-to-pitch ratio is between than one fourth and one half; and
the GRIN element emits the light in a converging beam.
5. (Withdrawn) The light-emitting device of claim 1, in which:
the length-to-pitch ratio is equal to one half; and
the GRIN element emits the light from a point source.

6. (Withdrawn – previously presented) The light-emitting device of claim 1, in which:

the light-emitting device additionally comprises a header comprising a threaded portion;

the light-emitting die is mounted on the header;

the GRIN element comprises a threaded portion; and

the threaded portion of the header is engaged with the threaded portion of the GRIN element.

7. (Withdrawn) The light-emitting device of claim 6, additionally comprising index matching material located in the cavity.

8. (Withdrawn) The light-emitting device of claim 6, in which:

the GRIN element defines a cavity comprising a side wall in which the threaded portion of the GRIN element is defined; and

the header comprises an external curved surface in which the threaded portion of the header is defined.

9. (Withdrawn) The light-emitting device of claim 6, in which:

the header defines a cavity comprising a side wall in which the threaded portion of the header is defined; and

the GRIN element comprises an external curved surface in which the threaded portion of the GRIN element is defined.

10. (Canceled)

11. (Currently amended) The light-emitting device of claim 10 ~~10~~ 1, additionally comprising index matching material located in the cavity.

12. (Canceled)

13. (Currently amended) A method of making a light emitting device, the method comprising:

providing a semiconductor light-emitting die;

providing a GRIN element having a cylindrical refractive index profile in which the refractive index varies radially and is substantially constant axially, the GRIN element comprising a first end surface opposite a second end surface and further comprising a cylindrical body having a first diameter, the cylindrical body characterized by a length-to-pitch ratio; and

arranging the GRIN element with the first end surface thereof adjacent the light-emitting die to receive light therefrom, the GRIN element emitting the light from the second end surface in a radiation pattern that depends on the length-to-pitch ratio;

providing a header comprising a cavity extending thereinto, the cavity having a second diameter slightly smaller than the first diameter, the light-emitting die mounted in the cavity defined by the header; and

providing a push fit hermetic seal defined by an assembly comprising the GRIN element and the cavity, the push fit hermetic seal being formed by engaging the GRIN element with the cavity.

14. (Withdrawn) The method of claim 13, in which:

providing a GRIN element comprises:

providing GRIN elements each having a cylindrical refractive index profile, comprising a first end surface opposite a second end surface, and characterized by respective length-to-pitch ratio, the length-to-pitch ratios differing among the GRIN elements, and

selecting one of the GRIN elements as a selected GRIN element, the selected GRIN element having a length-to-pitch ratio corresponding to a desired radiation pattern; and

in the arranging, the selected GRIN element is arranged with the first end surface thereof adjacent the light source.

15. (Withdrawn) The method of claim 13, in which providing a GRIN element comprises:

providing an elongate rod having a cylindrical refractive index profile characterized by a pitch; and

dividing off from the rod a lengthwise portion to provide the GRIN element.

16. (Withdrawn) The method of claim 15, additionally comprising dividing the rod lengthwise into portions, ones of the portions having different lengths to provide the GRIN elements of light-emitting devices having different radiation patterns.

17. (Withdrawn) The method of claim 13, additionally comprising:
providing an additional GRIN element having a cylindrical refractive index profile, comprising a first end surface opposite a second end surface and characterized by a length-to-pitch ratio different from the length-to-pitch ratio of the GRIN element; and
substituting the additional GRIN element for the GRIN element to change the radiation pattern of the light-emitting device.

18. (Withdrawn – previously presented) The method of claim 13, in which:
providing a light-emitting die comprises:
providing a header comprising a threaded portion, and
mounting the light-emitting die on the header;
the GRIN element comprises a threaded portion; and
the arranging comprises engaging the threaded portion of the header with the threaded portion of the GRIN element.

19. (Withdrawn) The method of claim 18, additionally comprising at least partially filling the cavity with index-matching material.

20. (Withdrawn) The method of claim 18, in which:
the GRIN element defines a cavity comprising a side wall in which the threaded portion of the GRIN element is defined; and
the header comprises an external curved surface in which the threaded portion of the header is defined.

21. (Withdrawn) The method of claim 18, in which:
the header defines a cavity comprising a side wall in which the threaded portion of the header is defined; and
the GRIN element comprises an external curved surface in which the threaded portion of the GRIN element is defined.

22. (Canceled)

23. (New) The light-emitting device of claim 1, in which the second diameter is smaller than the first diameter in a range of 30-40 μm .

24. (New) A light-emitting device (LED), comprising:
a semiconductor light-emitting die;
a gradient index (GRIN) element comprising a cylindrical body having a first diameter, a first flat end surface, and an opposing second flat end surface;
a header comprising a cavity extending thereinto, the light-emitting die mounted in the cavity defined by the header, the cavity having a second diameter slightly smaller than the first diameter of the cylindrical body of the GRIN element; and
a push fit hermetic seal defined by engaging the GRIN element with the header whereby the first flat end surface of the GRIN element is located adjacent the light light-emitting die to receive light therefrom and emit the light from the second flat end surface.

25. (New) The LED of claim 24 wherein the light emitted from the first surface is a collimated beam defined by a length-to-pitch ratio of the GRIN element.